

AD 660360
77-63214

Classification: Unclassified

Title: Ten Years of Biological Investigations of the
Soviet Antarctic Expedition (1956-1966)

/Desyat' Let Biologicheskikh Issledovaniy
Sovetskoy Antarkticheskoy Ekspeditsii/
(1956-1966)

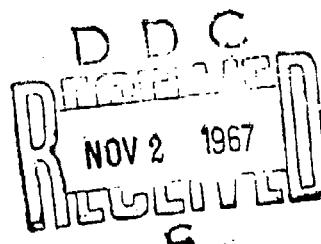
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Pages(s): 16

Source: Information Bulletin of the Soviet Antarctic
Expedition, No. 57, 1966, pp. 120-127
Arctic and Antarctic Scientific Research
Institute
Main Administration of the Hydrometeorological
Service of the Council of Ministers of the USSR

Original language: Russian

Translator: R



TRANSLATION NO. 2467

Approved by: _____

Date 9 October 1967

TEN YEARS OF BIOLOGICAL INVESTIGATIONS OF THE SOVIET
ANTARCTIC EXPEDITION (1956 - 1966)

The last ten years are characterized by the great progress in the development of biological investigations in the antarctic. It is now universally acknowledged that its complement of species, mode of existence, productive possibilities and origin render the antarctic fauna a unique phenomenon. A comprehensive study of this subject is of foremost importance, both from the theoretical and the practical standpoint. This situation has already been reflected by the decisions of the Third Advisory Conference of 12 countries - - signatories to the Antarctic Treaty (Brussels, 1964), during which they evolved a plan for a convention for the conservation of antarctic nature ("Approved Rules"). The first action of the Advisory Conference, as we know, was an agreement to declare Antarctica a non-atomic zone. The second action will be a convention for the establishment in Antarctica of the world's greatest game refuge. This international legal action is testimony to the great interest of the scientific community of many of the world's nations in the fauna of the extreme south and their great desire to study it.

Our country's biological investigations near the shores of the sixth continent began only ten years ago, in connection with the activities of the International Geographic Year

(prior to 1955 we have made only isolated faunal collections, connected mainly with the development of the whaling industry). The main task of biologists of the Soviet Antarctic Expedition (SAE) is the assembly of collected materials and observations required for comprehensive qualitative and quantitative characteristic of flora and fauna of Antarctica and its adjacent waters, and also for clarification of questions associated with the biogeography of the ocean.

The original collections and observations were carried out during the first three cruises of the specially equipped ship "Ob'" (1955-1958), additional material was furnished by hibernators, in the course of operations of the "Ob'" and of other SAE ships, by whaling fleets, and through international exchange of collections. Twenty-five biologists participated in the field research of the SAE (9 men had two tours of duty), all of them had previous oceanographic exploration experience.

The work was performed in accordance with a broad complex program designed, fundamentally, for the study of plankton, bottom-dwelling invertebrates and fish of the continental shelf and of abyssal depths; collections and observations of birds, seals and cetatians, surface and fresh-water flora and fauna were carried out on a more limited scale; parasitological and microbiological investigations and determinations of diurnal production of organic matter on the basis of radioactive carbon were performed during some of the cruises.

During the first two cruises of the "Ob'" biological work was performed chiefly in the Indian Ocean sector of the Southern Ocean, from the Capetown meridian eastward to the Balleny and Macquarie Islands. During the third cruise of the "Ob'" the investigations covered mainly the southern part of the Pacific Ocean, from Victoria Land to Drake Strait, inclusive (see "Information Bulletin SAE", No 3, 1958).

The following collection was accumulated by the Soviet Antarctic Expedition: approximately 3,600 samples of reticular and sedimentary plankton, 380 bottom-dredged and trawled samples, over 7,000 fixed fish, approximately 500 frozen sea birds' carcasses; herbarium material on mosses (314 specimens), lichens (592 specimens), algae of continental ponds (812 samples), seaweeds - macrofites (580 samples); 64 complete parasitological analyses of fish were performed, 1,135 microbiological analyses of water and of soils, 143 determinations of primary production (according to C_{14}) and others.

The significance of collected materials is very great. First, they furnish a basis for a series of monographs covering individual groups of Antarctica's animal life and its eco-geo-graphic characteristics. On the other hand, they greatly broaden the thematic capabilities of our marine biologists, enabling them to develop the various aspects of the biological bipolarity of the World Ocean on the basis of own data pertaining to the Arctic and Antarctica.

More than 50 specialists from the Institutes of the Academy of Sciences of the USSR, Universities, etc. have become engaged, to various extents, in the work of processing the above biological materials. The processing of the basic materials relating to certain groups of animals is now complete and a number of papers of the monographic type have been published, or are ready to be published (Spongia, Hydroidea Thecophora, Pennatularia, Antipatharia, pelagic Nemertini, many orders of Crustacea, individual Ascidiae; partially: Radiolaria, Foraminifera, Nematodes, Rotatoria, Polychaeta, Sipunculida, Bryozoa, Ciliata, Cirripedia, Echinodermata, Pisces, Aves and others); more than one hundred types of animals, new to science, are described; a number of ecolobiogeographic papers describing the peculiarities of distribution of plankton, bottom fauna and fish of Antarctica and of its adjacent waters have been prepared.

Publication of the results of biological investigations of the SAE has begun. Preliminary scientific reports and stationary lists of all cruises of the "Ob'" (see Papers of the SAE) have been published, also theses of the reports of the First Conference for the study of marine fauna of the antarctic (see "Information Bulletin SAE", No 3, 1958); approximately 150 articles published in various periodicals and in the first three volumes of the special series "Results of Biological Investigations of the SAE", 1962, 1964, 1966. Some of the results have been reported at international conferences.

We present a brief discussion of some of the results and conclusions obtained to date, after partial processing of SAE materials relating to plankton, benthos and fish.

P L A N K T O N ¹

¹ This Section compiled in collaboration with K.A. Brodskiy.

The most extensive plankton investigations were carried out during the first three SAE cruises aboard the diesel - electric ship "Ob" (1955-1958), additional material was obtained during the sixth and eighth cruises (1961, 1963) and at the Mirnyy Observatory (winter collections). Approximately 3,600 samples were taken at nearly 500 plankton stations established mainly in the southern portions of the Indian and Pacific oceans. Standard operations along all profiles were carried out with the aid of "Discovery" type nets (total recoveries 500 - 0, more rarely, from 1,000, 2,000 M and over), Dzhedi net (laminar recoveries from five levels, down to a depth of 500 M), bathometers for quantitative analyses of phytoplankton, less frequently, with an Ayzek-Kidd variable depth trawl and other equipment.

Processing of plankton data is not yet complete, but by this time a number of important groups of phytoplankton have been processed partially or completely (Beklemishev, Zernova), radiolaria (Petrushevskaya, Keshetnyak), Nemertinea (Morotkevich, 1964), Calanoida (Brodskiy and other, 1964), Cyclopoida (Shuvarov), Gammaridea (Birshteyn and Vinogradov,

1962), Hyperiidea (Vinogradov, 1962), Hysidacea (Birshteyn and Chindonova, 1962), Euphausiacea (Lomakina, 1964) and others. In these groups, in spite of the comparatively thorough knowledge of Antarctic plankton and of that of the adjacent waters, approximately 40 new types were described, which confirms the highly endemic character of Antarctic and notational plankton.

From the distribution of phytoplankton it was possible to establish six types of areas associated with hydrological frontal zones and to develop a phytogeographic regionalization of the pelagic of the Southern Ocean (Beklemishev, 1960).

As a result of processing of the most important group of zooplankton - Calanoida - we obtained new data relating to their systematism, populational variability (biometric analysis), ecology and areals. In particular, we established the fallacy of the former concept that a number of characteristic Antarctic and notational types (*Calanus propinquus*, *C. acutus*, *C. simillimus*, etc.) occur in the waters of the northern hemisphere. Interesting data relating to Calanoida from the southern part of the Pacific Ocean (third SAE cruise) led to the establishment of biogeographic zonality of this extensive, but not too well known aquatic area. Two areas were established: the Antarctic one (extending from the continent of Antarctica to the Antarctic convergence; characteristic types: *C. propinquus* and *C. acutus*) and the notational

(extending from the antarctic convergence to the sub-tropic convergence; characteristic types: *C. simillimus*, in the southern part and *C. australis* and *C. tensus* in the northern one).

Subsequent cruises of the "Ob'" (sixth and eighth) confirmed the correctness of the proposed regionalization and demonstrated the competency of establishment of similar biogeographic subdivisions in the Indian and Atlantic oceans. As a result of the analysis of distribution of plankton along the various profiles we made an attempt to determine the configuration of this border line and for the reasons for its latitudinal displacements (Naumov, Voronina, 1962 and 1963).

Availability of extensive planktonic collections, made by Soviet expeditions, covering the Antarctic Basin and various parts of the Pacific, Indian and Atlantic oceans now enables us to compare the planktonic fauna of all the latitudinal zones, from the North Pole to Antarctica. And similarly, all of the predominant types of Calanoida in the Arctic and in Antarctica merit attention - in both areas predominant types include only three to four varieties. However, the total number of types of Calanoida in the antarctic waters is twice as great (81 types) as the one found in the Arctic Basin (40 types).

Essential data was also obtained relative to size and distribution of the planktonic biomass (Vinogradov, Naumov, 1961), confirming and supplementing previous information as to the quantitative distribution of plankton in the southern hemisphere.

On the basis of SAE data it is possible to identify two zones of greatest planktonic biomass: 1) the southern zone (south of 60-65° S. Lat.) with an average biomass of summer plankton of the 100 - 0 M stratum of approximately 370 g/M^3 , and 2) northern zone (near the antarctic convergence) with an average biomass of approximately 300 mg/M^3 , forming not a continuous mass, but some isolated, latitudinally elongated spots. The above figures actually do not include the difficult to catch with ordinary nets Kril' (Euphausia superba and others), whose biomass is exceptionally great. Therefore, if we take into account the enormous supplies of antarctic Kril' and the fact that the productive regions of the southern hemisphere occupy much larger areas than the northern ones, there is good reason to assume that the total food resources of Antarctica are much greater than those of the Arctic and Subarctic waters.

Further investigation of plankton in the southern hemisphere must concentrate on studies of the ecology and dynamics of the number of mass forms and, especially, on those of the euphausian crayfish. The question of commercial

fishing and systematic processing of Krill' (into fodder meal, food products) within the next few years should be regarded as one of the most important practical tasks in the Southern Ocean, especially since the first steps in that direction have already produced encouraging results.

BENTHONIC INVERTEBRATES¹

¹ This Section prepared in collaboration with R.V.Ushakov

The Soviet Antarctic Expedition (SAE) aboard the diesel electric ship "Ob'" (1955-1958, 1963) made a collection of benthonic invertebrates on the continental shelf of Eastern Antarctica, sub-antarctic islands and adjacent waters, as well as from abyssal depths (a total of 290 stations). These collections represent a substantial addition to previous knowledge of the species composition of antarctic fauna, its high endemism and the distribution of the numerous antarctic species.

As a result of only partial processing of data, several decades of new species (and several genera) of benthonic invertebrates have already been described. For instance, among Spongia (Tetraxonida and Corniclespongida) 22 new species were established (Koltun, 1964), Hydroidea - 4 (Naumov, Stepan'yants, 1962), Nematodes - 6 (Platonova, 1958 and others), Polychaeta - 7 (Ushakov 1962; Levenshteyn, 1964), Sipunculida - 1 (Myrina, 1957), Cumacea - 5 (Lomakina, being printed),

Isopoda - 20 (Kusakin, 1966), Amphipoda - 8 (Gur'yanova), Decapoda - 1 (Zarenkov, 1966), Acarina - 3 (Sokolov, 1962), Pogonophora - 1 (Ivanov, 1960), Ascidiae - 5 (Vinogradova, 1962) and others.

In addition to characterization of individual groups of invertebrates, an attempt has been made to perform a biocenological analysis of benthos of the antarctic shelf, based on trawling and bottom dredging data of the SAE. It was found that one of the most typical bionomic features of this fauna is the extremely high mosaicity of its bottom grouping, but at the same time, a prevalence of relative monotony of the submarine landscapes within a wide range of depths (from 100 to 500-700 M), resulting in an absence of sharply defined vertical zonality.

Bottom groupings within the limits of the continental shelf (including the internal shelf depressions) are distinguished by their high polymorphism, that is, in most cases they consist of numerous representatives of various ecological groups, but still with a prevalence of slow-moving and sessile cestonophags; predominance of one or of a few species typical of arctic biosenoses is not usually found in the antarctic. The main background of the fauna consists of some highly diversified and numerous sponges, pearlweeds, various ccelenterata, echinoderms, ascidiac and other representatives of epifauna.

This unique picture of submarine landscapes, quite different from that of the Arctic, results to a large extent from the structural peculiarities and sedimentary accumulations of the antarctic shelf, characterized by weak grading of soils producing a similar range of ecological niches throughout the range of depths (Pasternak and Gusev, 1960; Koltun and Pasternak, 1961; Ushakov, 1963 and others).

Biologists of the SAE also performed some quantitative investigations of bottom fauna in the southern hemisphere, utilizing the dredge "Okean - 50" (183 quantitative samples). They obtained data relative to the distribution of the biomass (alcoholic weight) of the various benthonic groups along the Eastern Antarctic shelf and adjacent deep waters (up to 5000 Meters). The benthonic biomass at depths of 100-500 M was found to be very great (\approx aging $450-500 \text{ g/M}^2$), exceeding analogous figures of other, even most productive regions of the World Ocean. However, such high indexes of biomass in antarctica were obtained mainly because of the presence of non-nutrient groups (Spongia, Bryozoa, Ascidiae and others), which represented an average of more than 60% of the total biomass of animals. At depths of over 500 M the benthonic biomass diminishes abruptly and at depths in excess of 3000 M it averages 0.8 g/M^2 , which is also typical of other oceanic regions (Belyaev and Ushakov, 1957 and others).

During further investigations of bottom fauna, attention should be focused on the following questions: what is the

composition and structure of shallow-water bottom groups (using shallow-water diving techniques); are there differences between the benthos of the deep intrashelf depressions (pseudoabyssal) and similar depths along the slope of the continental shelf (bathyal); what is the composition of the ultra-abyssal fauna of Antarctica (in the South Sandwich depression); what is the nature and distribution of benthos underneath the large shelf glaciers, etc.

P I S H

As a result of ichthyological work of the SAE during the four cruises of the diesel/electric ship "Ob'" (1955-1958 and 1963), collections gathered by hibernators and by the whaling prospectors of the "Slava" and "Sovetskaya Ukraina" fleets, a volume of data, including more than three thousand specimens (approximately one hundred species), was accumulated solely in the antarctic area. Bottom fish were caught near the coast of Eastern Antarctica (between 10 and 162° E. Longit.), and also in the vicinity of numerous islands (South Shetland, South Georgia, Bouvet, Kerguelen, Heard, Macquarie, Balleny, Scott Island), from coastal depths to 1,600 M (once from a depth of 3,000 M).

A substantial amount of data relating to bathypelagic fish was obtained mainly through the use of the Ayzek-Kiddovskiy variable depth depression trawl (up to a depth of 2,000 M) in the antarctic waters of the Indian and Pacific

oceans. The volume of all of the collections may be considered sufficient for the preparation of a monograph on the fish of Antarctica.

On the basis of accumulated ichthyological material it became possible to make a number of additions to previously established concepts of the special composition, ecology and distribution of antarctic ichthyoфаuna - approximately 15 types new to science were discovered (in the Myctophidae, Trichiuridae, Nototheniidae, Harpagiferidae, Bathydraconidae, Chaenichthyidae, Zoarcidae and Bothidae families); specimens of previously unknown types were found near the shores of Eastern Antarctica, also some new genera and even families (Rajidae, Stomiatidae, Scopelarchidae, Trichiuridae, Bothidae and others); the areals of a number of benthic species were widened in their circumpolar directions; mass species of coastal and bathypelagic fish were identified, among them we also found certain types known previously only through unique specimens; we obtained data on the fauna of fish of such little-known regions as the eastern part of the Indian Ocean shelf of Antarctica, within the limits of 10 - 50° E. Longit. (20 species), deep waters of the southern part of the Pacific Ocean and in other locations.

Extensive use of roentgenoscopy in the processing of all collected materials increased the precision of morphological characteristic of antarctic species, with allowances made for

the variations of the identifying features within the massive volumes of the available material.

Some ichthyologists, working on live specimens, established the leukemic nature of most species of the family Chaenichthyidae and so, taking into account some other data (Huud 1954, 1958), we can now consider it to be an accepted fact that this unique feature among vertebrates (absence of erythrocytes and of hemoglobin in the blood) is a characteristic feature of the entire Chaenichthyidae family.

Analysis of the bathymetric data has revealed that the greatest special variety in the fauna of benthic fish caught in the northern seas, usually within the upper 100 M of the shelf, is shifted to a depth of 300 - 500 M along the shores of Eastern Antarctica. This interesting bathymetric anomaly is apparently the result not only of extremely unfavorable glacial effect on the coastal fauna, but also of the submerged nature of the antarctic shelf and the presence of deep internal depressions within the shelf boundaries (Andriyashev, 1964).

Examination of voluminous and wide-spread Antarctic fish of the Myctophidae family enabled us to project the zoogeographic zonality in the southern part of the Pacific Ocean and to single out the species-indicators of the antarctic convergence (Andriyashev, 1962).

A "Review of the Fauna of Antarctic Fish" has been published in this country and abroad. This publication includes an up to date faunal and eco-geographic essay which discusses the basis of the scheme of zoogeographic regionalization of the antarctic region (on the basis of benthic fish) and which deals with certain questions relating to the origins of the fauna of fish and the problems of future ichthyological investigations (Andriyashov, 1964; Andriyashov, 1965).

Important investigations were performed by the expedition of the All-Union Institute of Fisheries and Oceanography (VNIRO) in the Scotia Sea and surrounding waters in 1965. This expedition utilized the scientific-industrial ship "Akad.Knipovich" and was under the direction of Prof. U.U.Marti. In addition to compiling some very voluminous and valuable collections (U.E.Permitin) the expedition accomplished some very successful fishery prospecting work, as a result of which they established the presence of some large masses of pelagic codfish -- patagonian putassu (*Micromesistius australis*): catches of this valuable fish in antarctic waters of Scotia Sea exceeded 10 T per lift of the variable depth trawl.

Today there is good reason for planning not only a continuation of eco-faunal investigations in Antarctica, but also of the initiation of scientific- professional work aimed toward a rational utilization of the fish and crustacean (Kril')

resources of the highly productive antarctic waters. The accumulated stocks of information relating to systematism, biology and distribution of fauna of the Southern Ocean, originally thought to be of purely theoretical interest, are now acquiring a more definite meaning in the process of resolving of some practical problems.
